METHOD AND APPARATUS TO MINIMIZE AIR-SLURRY SEPARATION DURING GYPSUM SLURRY FLOW

BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for preparing gypsum products (i.e., products comprising calcium sulfate dihydrate) from starting materials comprising calcined gypsum (i.e., calcium sulfate hemihydrate or anhydrite) and water. More particularly, the present invention relates to an improved method and apparatus for use in conjunction with the slurry mixer typically used in supplying agitated gypsum slurry to a wallboard production line. The present apparatus provides an improved conduit leading from the mixer which minimizes air-slurry separation during gypsum slurry flow through the conduit to the outlet.

It is well known to produce gypsum products by uniformly dispersing calcined gypsum in water to form a slurry and then casting the slurry into a desired shaped mold or onto a surface and allowing the slurry to set to form hardened gypsum by reaction of the calcined gypsum (calcium sulfate hemihydrite or anhydrite) with the water to form hydrated gypsum (calcium sulfate dihydrate). It is also well known to produce a lightweight gypsum product by uniformly mixing an aqueous foam into the slurry to produce air bubbles. This will result in a uniform distribution of voids in the set gypsum product if the bubbles do not escape from the slurry before the hardened gypsum forms. The voids lower the density of the final product, which is often referred to as "foamed gypsum."

Prior apparatus and methods for addressing some of the operational problems associated with the production of foamed gypsum are disclosed in commonly-assigned U.S. Pat. Nos. 5,683,635, 5,643,510, 6,494,609 and 6,874,930 which are incorporated by reference. The present invention relates generally to the use of foamed gypsum in the production of gypsum wallboard.

A gypsum wallboard mixer typically includes a housing defining a mixing chamber with inlets for receiving calcined gypsum and water, among other additives well known in the art. The mixer includes an impeller or other type of agitator for agitating the contents to be mixed into a mixture or slurry. Such mixers typically have a rectangular discharge gate or slot with a cutoff block or door. The discharge gate controls the flow of slurry from the mixer, and is difficult to adjust to change slurry flow when product requirements change, such as when thicker or thinner wallboard is desired.

It has been found that it is desirable to reduce the pressure of the slurry in the slurry conduit before the slurry leaves the conduit outlet in order to avoid disrupting the distribution of the previously deposited slurry in a wallboard production line. This is accomplished by providing one or more changes of direction of the conduit between the mixer and the conduit outlet, such as by providing one or more elbows or bends along the length of the conduit and also by enlarging a cross section of the flow stream of slurry in the conduit while at the same time changing the direction of the flow stream. In the known constructions, the enlargement of the flow stream and the changing of the direction of the flow stream take place simultaneously in a boot which comprises a 90 degree elbow that has an increasing diameter throughout the 90 degree bend of the elbow.

When the slurry-foam additive mixture is such that the air content approaches or exceeds 40%, then as the flow stream of the mixture passes through the elbow with the enlarging diameter, there is a significant and undesirable separation of the air from the slurry.

Therefore, it would be an improvement in the art if there were a method and an apparatus that still provided for reducing the pressure of the slurry flow stream via changes of direction of the conduit and increases in the diameter of the flow stream, while reducing the amount of separation of the air from the slurry in the conduit.

SUMMARY OF THE INVENTION

What the inventors have surprisingly discovered is that changing the direction of flow of the flow stream at the same time as enlarging the cross section of the flow stream causes a greater separation of the air from the slurry than if the changing of the direction of the flow stream and enlarging a cross section of the flow stream take place at different times and at different spatial locations.

Accordingly, an unexpected improvement is provided by the present apparatus and method in which a conduit is used to discharge the slurry from the mixer in which the changing of the direction of the flow stream in the conduit and an enlargement of the cross section of the flow stream are both provided, yet at different times and spatial locations.

In an embodiment, a method for providing an evenly mixed additive enhanced gypsum slurry to a web includes inserting calcined gypsum and water into a mixing chamber of a mixer through at least one inlet of the mixing chamber, agitating the contents of the mixing chamber to form a slurry comprising an aqueous dispersion of the calcined gypsum, passing the slurry from an outlet of the mixer into a slurry dispensing apparatus including a conduit, introducing an additive into the slurry at a point along a length of the conduit in the slurry dispensing apparatus to achieve a flow stream of a slurry/additive mixture through the conduit, and expanding a cross section of the flow stream in the conduit while not changing a direction of the flow stream and changing a direction of the flow stream while not expanding the cross section of the flow stream and conduit prior to the flow steam exiting from an outlet of the conduit.

In still another embodiment, an apparatus is configured for connection to a mixer for receiving a gypsum slurry, which includes a conduit having a main inlet in slurry receiving communication with the mixer outlet and extending in a downstream direction to a spout for discharging the slurry, the conduit providing a flow path for a flow stream of the slurry, at least one bend in the conduit to cause a change of direction of the flow stream between the main inlet and the spout, wherein a cross section of the flow stream does not expand in the bend, and at least one expansion section in the conduit to cause an expansion of a cross section of the flow stream between the main inlet and the spout, wherein the flow stream does not change direction in the at least one expansion section.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of the present invention which are believed to be novel, are set forth with particularity in the appended claims. The invention, together with further objects and advantages, may best be understood by reference to the following description taken in conjunction with the accompanying drawings, in the several Figures in which like reference numerals identify like elements, and in which:

FIG. **1** is a fragmentary schematic overhead plan view of a mixing apparatus incorporating the features of the invention.

FIG. **2** is a side elevational view of a first embodiment of the pressure reducing apparatus of FIG. **1** shown in isolation.